REMARKS

Claims 1-10, 12, 16 and 18-20 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Wu et al. (U.S. Patent No. 6,493,365) in view of McIntyre (U.S. Patent No. 5,319,257). Claims 11, 13-15 and 17 have been similarly rejected over Wu et al. in view of McIntyre, as applied to Claim 1 and 16 above, and further in view of Jerman et al. (U.S. Patent No. 5,998,906). Reconsideration of these claims is respectfully requested.

Wu et al. disclose an apparatus for passively stabilizing the optical pathlength in tunable lasers. FIG. 3 thereof is an isometric view of a hardware embodiment of a signal generator 250 having a base 300, fiber mount 302, fiber coupling 304, motor bracket 310, laser diode housing 330, diffraction grating 340, grating mount 342, retroreflector 350, compensating element 352, pivot bracket 354, actuator 370, drive train 376 and start condition sensors 390-392. Col. 6, lines 37-43. In an embodiment of the invention, the actuator is a rotary stepper motor. Other actuators may be used with equal advantage, including, but not limited to: linear stepper motors, piezo-electric stacks, bimetallic elements, AC/DC motors, etc. Col. 7, lines 15-19. The actuator 370 is coupled to the base 300 via motor bracket 310 and strap 440. The individual components of the drive train 376 are visible and include: drive shaft 400, hub and rim 402-404, rotary flex member 406, compensating element 410, translation unit 412, cylindrical nut 414, lead screw 418, and linear flex member 420. The drive train 376 comprises rotary, linear, and arcuate portions. Generally the drive shaft converts the rotary motion of shaft 400 to linear movement of compensating block 410 and finally to arcuate movement of the tip 430 of the pivot arm to which the bracket 354 and associated retroreflector 350 are attached (See FIG. 5). This provides for the tuning of the output beam of the laser. Col. 7, lines 34-47. Where the accuracy of the linear start condition sensor alone is insufficient to indicate a unique starting condition, the rotary start condition sensor 392 may be used in combination with the linear sensor. Col. 12, lines 4-7. In still another embodiment of the invention, microswitches, capacitative sensors inductive sensors, magnetic read switches, etc. could be utilized to signal the start condition. Col. 12, lines 31-34.

McIntyre discloses a uniaxial drive system or microactuator capable of operating in an ultra-high vacuum environment. The uniaxial constant velocity microactuator 10 is shown in FIG. 1 with an axially movable cylindrical shaft 11 therethrough. The microactuator moves the shaft 11 in nanometer increments along the direction of the shaft's rotational axis. The microactuator 10 consists of a single rectangularly-shaped housing member 12 comprising two axial end portions 13, 15, and an axial center portion 14; the portions 13-15 being arranged along the shaft 11 axis. The end portion 13 of housing 12 contains a clamp/pusher assembly 16 therewithin behind an end cap 26, and has a number of vertical lateral flexures 22 spaced about

its exterior. In similar manner, end portion 15 of housing 12 contains a clamp/pusher assembly 17 therewithin behind a similar end cap 27 (shown in FIG. 2), and has a number of horizontal lateral flexures 23 spaced about its exterior. Col. 2, line 61 through Col. 3, line 8. Clamp/pusher assembly 16 includes a clamper piezoelectric 60 and a pusher piezoelectric 61 (FIG. 2) that are energized through electrical leads 18, 19, respectively. Similarly, electrical leads 20, 21 are used to power a clamper piezoelectric 70 and a pusher piezoelectric 71 in the clamp/pusher assembly 17. Col. 3, lines 18-24. Once a clamper pad 32, clamper piezoelectric 60, lower and upper clamp holders 37, 38, and clamper lid 39 have been assembled on a clamper frame 36, spacer rings 42, 43 are connected to both sides of the clamper frame 36. The spacer rings 42, 43 serve to stand off two large flexure rings 44, 45 from the clamper frame 36. The large flexure rings 44, 45 guide the shaft-axial motion of the clamp/pusher assembly 16 once it is fixed in place in the recess 30 in housing 12. The spacer rings 42, 43 and large flexure rings 44, 45 are held to the clamper frame 36 by a locking ring 46 screwed into one side of frame 36, and a locking ring/pusher housing 47 on the other. Col. 4, line 60 through Col. 5, line 16. The pusher piezoelectric 61 is press fit into housing 47 by means of a set of three sheet metal leaf springs 48. The leaf springs 48 help to axially align and fix the position of pusher piezoelectric 61 in housing 47, but do not hinder the operation of pusher piezoelectric 61 once assembled. Col. 5, lines 20-25. In the prototype, shaft 11 is superinvar, for example, for its very low thermal coefficient of expansion. Aluminum oxide clamper pads 32 on a superinvar shaft 11 act as a very clean solid bearing system. Col. 7, lines 39-43. The other materials of construction may include aluminum, stainless steel and piezoelectric ceramic. The piezoelectric material may be lead zirconate titanate, for example. Col. 7, lines 51-54. FIG. 7 compares a typical output profile for the commercially available Burleigh Inchworm stepper motor with the microactuator of McIntyre. Col. 5, lines 62-64.

Claim 1, is patentable by calling for a tunable single mode laser operable over a range of wavelengths of the type set forth therein having, among other things, an electromechanical micro-actuator coupled to one of the diffractive element and the reflective element for causing angular movement of such element to permit selection of a single wavelength from the range of wavelengths by altering the optical path of the light.

In rejecting Claim 1 over Wu et al., the Examiner acknowledges that Wu et al. disclose a tunable laser in a Littman-Metcalf configuration, whose structural arrangement and operation is well known in the art, but is silent as to the use of a microactuator, which implies small in size. The Examiner further states that McIntyre discloses a microactuator used for positioning in nanometer increments, and suggests replacing the stepper motor of Wu et al. with a microactuator due to the smooth and continuous motion.

A proper analysis of the obviousness/nonobviousness of the claimed invention under 35 U.S.C. §103(a) requires consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should carry out the claimed invention; and (2) whether the prior art would also have revealed that in so carrying out the claimed invention, those of ordinary skill would have a reasonable expectation of success. Both the suggestion and the reasonable expectation of success must be founded in the prior art, not in the applicant's disclosure. In re Sernaker, 217 U.S.P.Q. 1, at 5 (Fed. Cir. 1983); and In re Vaeck, 20 U.S.P.Q.2d 1438, 1442 (CAFC 1991).

In the present case, the rejection of the claims under 35 U.S.C. §103 is in error because Wu et al. fail to provide the requisite suggestion/motivation to provide a laser system of the type called for therein having, among other things, at least one microactuator coupled to one of the diffractive element and the reflective element. The Examiner acknowledges that Wu et al. fail to disclose a microactuator. In addition, however, Wu et al. fail to disclose that the apparatus therein could be scaled down in size so as to utilize a microactuator of the type called for in Claim 1. A change in scale of a system imposes restrictions on the design of such a system. Conventional systems cannot be arbitrarily shrunk in size and be expected to work in an analogous manner. Making systems on a micro scale typically requires novel solutions to conventional engineering problems, none of which are suggested or disclosed by Wu et al.

Similarly, McIntyre does not provide the requisite motivation to add at least one microactuator to a tunable laser of the type disclosed in Wu et al. In this regard, McIntyre does not disclose or even discuss a laser system. Rather, McIntyre merely discloses an actuator capable of moving a shaft in nanometer increments along the direction of the shaft's rotational axis. More specifically, the actuator of McIntyre was developed to fulfill the positioning requirements of the National Institute of Standards and Technology Molecular Measuring Machine. See Col. 1, lines 21-25. McIntyre states that the actuator thereof was developed to provide ultra-precise scanning and indexing in a remote environment, and further states that highly accurate, repeatable positioning in the sub-manometer regime is a necessity when performing dimensional metrology. McIntyre adds that his microactuator is ideally suited for positioning or scanning a myriad of atomic resolution microscopes as well as many other sensors or transducers See Col. 6, lines 35-43. As can be seen, there is no disclosure by McIntyre that his actuator would be suitable for use with a tunable laser or with the components of any other optical system. If relevant at all, McIntyre's discussion of an atomic resolution microscope implies that his actuator moves the whole microscope, not components thereof.

Although the Examiner states that a microactuator implies an actuator that is small in size, McIntyre does not disclose such a microactuator. Hence, Applicant submits that McIntyre

further fails to provide the requisite motivation to add at least one microactuator to a tunable laser of the type disclosed in Wu et al. Webster's Third New International Dictionary (Unabridged) agrees with the Examiner and defines the adjective "micro" as meaning "small or minute in size." Applicant's microactuator is indeed "small or minute in size." In this regard, Applicant states on Page 9 beginning at line 14 of the application with respect to Figure 2: "In an exemplary embodiment, the optical path length of the external cavity (a sum of the optical distance between the front facet of the laser 101, the grating 103, and the front of the reflector 104) is approximately 5 nm..." It is further noted on Page 14 of the application beginning on line 22 with respect to actuator 105 in Figure 11 that "In the exemplary embodiment, the reflector 104 is about 2 mm long by 400 um high." From a rough approximation in Figure 11 utilizing such exemplary length of reflector 104, it would appear that actuator 105 is approximately 4 millimeters (0.16 inch) wide and approximately 6 millimeters (0.24 inch) long.

In contrast, the microactuator disclosed in McIntyre is significantly larger than the microactuator called for in Claim 1. For example, McIntyre compares a typical output profile for the commercially available Burleigh Inchworm stepper motor with his microactuator. Burleigh has been purchased by EXFO. As can be seen from the dimensions set forth on Page 2 of the attached brochure of EXFO Burleigh Products Group Inc. entitled INCHWORM Motors, the smallest EXFO Burleigh Inchworm stepper motor appears to have a length of slightly more than 84.90 millimeters (84900 microns or 3.54 inches) and a diameter of 25.1 millimeters (25100 microns or 0.99 inch). When configured with a rotations stage (RS-800), such smallest motor appears to have a length of 125.2 millimeters (125200 microns or 5.41 inches) and a diameter of 1.49 inch. Further, as disclosed and illustrated in McIntyre, and as noted above, the actuator in FIG. 3 of McIntyre appears to utilize conventional screw heads, which suggests that the diameter of such McIntyre actuator would be on the order of one inch. It thus appears that in fact the actuator of McIntyre is at least an order of magnitude greater in size than the microactuator called for in Claim 1.

Even if an actuator of McIntyre, or in fact a microactuator of the type disclosed by Applicant, is combined with an apparatus of the type disclosed in Wu et al., there is no suggestion or disclosure in the prior art that in so carrying out such combination those of ordinary skill would have a reasonable expectation of success. As can be appreciated by those skilled in the art, the field of microactuator design is still nascent. Contrary to the belief of the Examiner, it cannot be assumed that any particular actuator configuration can be developed or is physically possible. Hence, there is no reasonable expectation that the inclusion of at least one microactuator of the type called for in Claim 1 in an apparatus such as disclosed in Wu et al.

would be successful in producing a tunable single mode laser, let alone a tunable single mode laser as called for in Claim 1.

In view of the foregoing, the Examiner's rejection of Claim 1 as being obvious over Wu et al. in view of McIntyre is improper and should be withdrawn. Claim 1 should be found allowable.

Claims 2-12 depend from Claim 1 and are patentable for the same reasons as Claim 1 and by reason of the additional limitations called for therein. For example, Claim 6 is additionally patentable by providing that the angular movement comprises a translation and a rotation, which is not suggested or disclosed by the prior art. Claim 12 is additionally patentable by providing that the micro-actuator is a rotatable micro-actuator.

Claim 13 is patentable by calling for a tunable laser comprising source means for providing a light along an optical path with any wavelength selected from a bandwidth of wavelengths, a diffractive element positioned in the optical path and spaced from the source by a first distance to redirect the light, a reflective element positioned in the optical path and spaced from the diffractive element by a second distance to receive the redirected light from the diffractive element and to redirect the light back towards the diffractive element, the light being redirected by the diffractive element back towards the source, and an electrically-driven micro-actuator for selecting the wavelength from the bandwidth of wavelengths by altering the optical path of the light between the diffractive element and the reflective element, the micro-actuator including a substrate and at least one rotary comb drive carried by the substrate.

Contrary to the assertion of the Examiner, and as discussed above, the rejection of Claim 13 under 35 U.S.C. §103 is in error because Wu et al. fail to provide the requisite suggestion/motivation to provide a laser assembly of the type called for therein having, among other things, an electromechanical microactuator coupled to one of the diffractive element and the reflective element and McIntyre does not provide the requisite motivation to add an actuator to a laser assembly, let alone a microactuator of the type called for in Claim 13 to a laser system of the type disclosed in Wu et al.

The inclusion of Jerman et al. does not remedy such erroneous rejection as there is no suggestion or disclosure in Jerman et al. that the comb drive assemblies disclosed therein would be suitable for use in a relatively large piezoelectric driven actuator of the type disclosed in McIntyre, let alone in a tunable laser of the type called for in Claim 13. In this regard, a comb drive assembly is electrostatically driven, while the microactuator of McIntyre is piezoelectrically driven. Such principles of operation are quite different and do not permit, as appears to be suggested by the Examiner, a comb drive assembly to be substituted into a piezoelectrically actuated microactuator to provide a workable device. There is further no

suggestion in Jerman et al. that the microactuator thereof would be suitable for use in a tunable laser.

Even if a microactuator of Jerman et al. was combined with a laser assembly of the type disclosed in Wu et al., there is no suggestion or disclosure in the prior art that in so carrying out such combination those of ordinary skill would have a reasonable expectation of success. In this regard, there is no suggestion or disclosure in Jerman et al. that the microactuator thereof would be suitable for selecting a wavelength from a bandwidth of wavelengths by altering the optical path of the light between a diffractive element and a reflective element. Applicants further reiterate that the field of microactuator design is still nascent and thus it cannot be assumed that any particular actuator configuration can be developed or is physically possible.

Claims 14-15 depend from Claim 13 and are patentable for the same reasons as Claim 13 and by reason of the additional limitations called for therein.

Claim 16 is patentable for reasons similar to those discussed above with respect to Claim 1 by calling for a method for using a tunable single mode laser microassembly to provide light with any wavelength selected from a range of wavelengths, comprising the steps of providing the light along an optical path, providing a diffractive element in the optical path to diffract the light, providing a reflective element in the optical path to reflect the light and selecting a single wavelength of light by altering the optical path of the light by means of a micro-actuator coupled to the reflective element for causing angular movement of the reflective element.

Claims 17-20 depend from Claim 16 and are patentable for the same reasons as Claim 16 and by reason of the additional limitations called for therein. For example, Claim 18 is additionally patentable for reasons discussed above with respect to Claim 6.

In view of the foregoing, it is respectfully submitted that the claims of record are allowable and that the application should be passed to issue. Should the Examiner believe that the application is not in a condition for allowance and that a telephone interview would help

further prosecution of this case, the Examiner is requested to contact the undersigned attorney at the phone number below.

Respectfully submitted,

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